Theoretical Analysis of Heat Transfer and Friction Factor for Turbulent Flow of Nanofluids through Pipes.

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Abstract

A numerical model for determining the turbulent characteristics of fluid flow and heat transfer is presented, treating certain constants in the van Driest eddy diffusivity equation of momentum and heat as variables. The viscosity and thermal conductivity of nanofluids are estimated using regression equations. It was observed that the turbulent characteristics of nanofluids are different from those of water. The numerical results indicate a higher velocity of SiO_2 nanofluid and lower eddy diffusivity compared to Cu under similar operating conditions. The nanofluid temperature gradient increases with concentration and decreases with temperature. However, the temperature gradient is significantly influenced by the particle density. Equations for estimating the coefficient and the Prandtl index in the eddy diffusivity equations of momentum and heat, respectively, are developed as a function of Reynolds number, concentration, and nanofluid properties. The Prandtl index value decreases with increasing concentration, reflecting the reduction in heat transfer coefficients observed at lower operating temperatures.

Keywords: nanofluids, eddy diffusivity, density, heat transfer coefficient, friction factor

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